DPDK’s Best Kept Secret: Micro-benchmarks

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Why should I care about DPDK Micro-benchmarks?
What do they benchmark?
How do I run them?
Not all slots are made equal

Ensure that you have plugged in your NIC card in most optimal slot
How many lcores, you think, are there in this 2 socket server?

- 64 lcores?
- 96 lcores?
- More than 100 lcores?
Question: What can be Improved here?
I/O Plugged in CPU1's Slot
How much memory do you see in CPU1 node?
ZERO!

CPU 0 has only One Channel memory populated.
Question:
In which socket you think lcore# 50 resides? – socket 0? Or socket 1?

- Assume NIC is Plugged in socket 0
- Will the performance be best or sub-optimal?
Why Should I Care About DPDK Micro-benchmarks?

We thought lcore # 50 resides in socket 0.

But actually, you can see it is in socket 1.

So, NIC in socket 0 is actually sub-optimal.

How to quantitatively ensure that system is set for optimal performance?
QUIZ: Cores Within A Socket – All In Same Loop?

4-8 Core (LCC)
Cores Within A Socket – Not equal proximity

14-18 Core (HCC)
Prior to application level benchmarking...

- Without tightening these, if you start developing your application...
- And on top of that, if you start measuring application level performance
- Root cause analysis is made unnecessarily complex

Instead... what if..

- What if you can do basic benchmarking of key performant elements / ops
- You will build strong foundation first
- Will help you develop Applications confidently towards overall higher performance
What Objects, What Operations to benchmark?

In other words, what are the key high performant **objects** and **operations**?

**Objects:**
- Ring
- Mem pool
- Mbuf

**Operations:**
- Mem copy
- Hash Operations
- Flow Classification
Hash – Multi-writer – Transactional Memory

```c
void test_hash_multiwriter_main(void)
{
    if (rte_lcore_count() == 1) {
        printf("More than one lcore is required to do multiwriter test\n");
        return 0;
    }

    setlocale(LC_NUMERIC, "");

    if (!rte_tm_supported()) {
        printf("Hardware transactional memory (lock elision) "
            "is NOT supported\n");
    } else {
        printf("Hardware transactional memory (lock elision) "
            "is supported\n");

        printf("Test multi-writer with Hardware transactional memory\n");

        use_htm = 1;
        if (test_hash_multiwriter() < 0)
            return -1;

        printf("Test multi-writer without Hardware transactional memory\n");
        use_htm = 0;
        if (test_hash_multiwriter() < 0)
            return -1;
    }

    return 0;
}
```
Tests: Ring, PMD, Table

test_ring.c
test_ring_perf.c
test_pmd_perf.c
test_pmd_ring.c
test_pmd_ring_perf.c
test_table.c
test_table.h
test_table_acl.c
test_table_acl.h
test_table_combined.c
test_table_combined.h
test_table_pipeline.c
test_table_pipeline.h
test_table_ports.c
test_table_ports.h
test_table_tables.c
test_table_tables.h
Router, Memcpy, Hash

test_lpm.c
test_lpm6.c
test_lpm6_data.h
test_lpm6_perf.c
test_lpm_perf.c
test_malloc.c
test_mbuf.c
test_member.c
test_member_perf.c
test_memcpy.c
test_memcpy_perf.c
test_memory.c
test_mempool.c
test_mempool_perf.c
test_memzone.c
test_hash.c
test_hash_functions.c
test_hash_multiwriter.c
test_hash_perf.c
test_hash_scaling.c
Tests: Crypto, Event, Flow Classify

test_cryptodev.c
test_cryptodev.h
test_cryptodev_aead_test_vectors.h
test_cryptodev_aes_test_vectors.h
test_cryptodev_blockcipher.c
test_cryptodev_blockcipher.h
test_cryptodev_des_test_vectors.h
test_cryptodev_hash_test_vectors.h
test_cryptodev_hmac_test_vectors.h
test_cryptodev_kasumi_hash_test_vectors.h
test_cryptodev_kasumi_test_vectors.h
test_cryptodev_snow3g_hash_test_vectors.h
test_cryptodev_snow3g_test_vectors.h
test_cryptodev_zuc_test_vectors.h

test_event_eth_rx_adapter.c
test_event_ring.c
test_eventdev.c
test_eventdev_octeontx.c
test_eventdev_sw.c

test_flow_classify.c
test_flow_classify.h
/* Mempool performance
 * ======*
 * Each core get \*n\_keep\* objects per bulk of \*n\_get\_bulk\*. Then, objects are put back in the pool per bulk of \*n\_put\_bulk\*.
 * This sequence is done during TIME\_S seconds.
 * This test is done on the following configurations:

- Cores configuration (\*cores\*)
  - One core with cache
  - Two cores with cache
  - Max. cores with cache
  - One core without cache
  - Two cores without cache
  - Max. cores without cache
  - One core with user-owned cache
  - Two cores with user-owned cache
  - Max. cores with user-owned cache

- Bulk size (\*n\_get\_bulk\*, \*n\_put\_bulk\*)
  - Bulk get from 1 to 32
  - Bulk put from 1 to 32

- Number of kept objects (\*n\_keep\*)
  - 32
  - 128
*/
Cycle Cost [Enqueue + Dequeue] in CPU cycles

Different Block sizes
1, 2, 4, 8, 16, 32
Call To Action: Where To Find Them & How It Measures?

The app directory contains sample applications that are used to test DPDK (such as autotests) or the Poll Mode Drivers (test-pmd):

```
app
  +-- chkincs  # Test program to check include dependencies
  +-- cmdline.test  # Test the commandline library
  +-- test  # Autotests to validate DPDK features
    +-- tests  # Test and benchmark poll mode drivers
    +-- test-acl  # Test the ACL library
    +-- test-pipeline  # Test the IP Pipeline framework
    +-- test-pmd  # Test and benchmark poll mode drivers

/* Delete */
status = 0;
begin = rte_rdtsc();
for (i = 0; i < NUM_ROUTE_ENTRIES; i++) {
    /* rte_lpm_delete(lpm, ip, depth) */
    status += rte_lpm_delete(lpm, large_route_table[i].ip,
                             large_route_table[i].depth);
}

total_time += rte_rdtsc() - begin;
printf("Average LPM Delete: %g cycles\n",
       (double)total_time / NUM_ROUTE_ENTRIES);
```
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Questions?

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